Linking Economic and Environmental Goals in NOAA's Strategic Planning

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Introduction

In its 1998 Strategic Plan, NOAA noted a number of ways in which it's activities and programs affect the economy, from the "one seventh of the national economy" that is weather sensitive to the dependence of maritime transportation on the charting and navigational services provided by NOAA. That Strategic Plan noted "NOAA will continue to strengthen the linkage between its economic and environmental goals". Explicitly considering economics in NOAA's new strategic plan can strengthen those links in two important ways:

1. First, applying an economic perspective in the definition and formulation of mission, goals, objectives, outcomes, and performance measures explicitly links NOAA programs and activities to social and economic benefits important to the national economy. Economic benefits, in turn, is the language of non-specialists in the OMB, Congress, and the general public.

2. Second, using economic data and analysis can significantly improve Performance Measures by explicitly linking them with the strategic plan. In fact, expanding and improving economic data and analysis for NOAA's programs should be a strategic priority in its own right, complete with mission, goals, strategic actions, and performance measures.

Providing economic perspectives on NOAA's activities may seem difficult since NOAA has traditionally been seen, both by itself and others, as a "science" agency, with only limited relevance to the economy. But NOAA's activities have always been directly connected to the economy, and these connections have become even more important and visible in recent years. This can most easily be seen by considering NOAA's activities in terms of two economic paradigms: first, its role in the "knowledge economy" and, second, its role in helping to manage the resources upon which the ocean and coastal economy depends.

NOAA and the Knowledge Economy

NOAA has traditionally defined much of its mission as being that of a "science" agency involved in the collection and analysis of data on the atmosphere and oceans and in both basic and applied research and forecasting in such fields as meteorology, climatology, and physical and biological oceanography. It has also played a principle role through its coastal surveying and mapping in development of navigation information. In short, NOAA is fundamentally in the information business, including the production, analysis, and dissemination of information.

NOAA's role as an information resource makes it a key player in its field in what has come to be called the "knowledge economy". To be sure, there was never an economy that did not depend on knowledge to be successful. The concept of the knowledge economy refers to recent developments in science, technology, and information handling that together greatly increases the role that knowledge plays in the economy. Those developments include:

- The ability to store, retrieve, and analyze massive amounts of information at miniscule costs per unit of information using the computer.
- The ability to communicate large quantities of information at essentially zero marginal cost through the Internet and broad-band communications technologies
- The development of software and hardware combinations that make large quantities of information easily available to a mass population, while also permitting more complex analyses of data than ever before.
- The growth of a technologically literate and highly educated population that not only can use the information available, but also greatly expands the demand for information as new uses of information are continually invented.

An analysis of long-range trends impacting NOAA by the Hudson Institute noted that technological change has been especially rapid during the last two decades and is increasingly impacting every aspect of society. Indeed, "with fundamental knowledge expanding, and with so much knowledge being processed with modern information handing techniques, interactions among fields are flourishing. Convergence is occurring both in science and applications." [Hudson].

Thus, on both the supply and demand sides, information permeates the creation of economic wealth in an unprecedented way. Arguably, NOAA is unique among Federal agencies in the ability to capitalize on these changes. For instance, NOAA weather and climate forecasts either directly or indirectly service as much as one quarter of the U.S. Gross Domestic Product (about $2.7 trillion) that is weather sensitive.[1] The nearly 105 million households in the U.S. consult the day's weather forecast at least once a day [Stratus, Weather].

The economic benefits of this information for the general public to protect lives and property are known to be quite significant. The most obvious effects are in such things as storm forecasts and the ability to take appropriate action in a timely manner when hurricanes, strong thunderstorms or other major storm events occur. Average annual damages from such events are over $11 billion. Even small changes in the speed and accuracy of forecasts can lead to avoiding some of these storm damages.

Further, forecast improvements can produce very large economic benefits in daily activities. It is estimated that US households are willing-to-pay (value) at least $11.5 billion annually for current daily weather information, and studies suggest potential willingness to pay for improved weather forecasts is as high as $1.2 billion per year [Stratus, Weather].

Such potential economic improvements are accompanied by less obvious but no less important changes such as:

- Improvements in scale, time horizon, and accuracy of weather forecasts have permitted the development of much more cost effective forms of insurance for weather-sensitive activities, including the development of a $1.8 billion dollar annual market in "weather derivatives" in which the risks of adverse weather conditions can be hedged in the same way that other risks are managed. Managing risk this way is not possible without good information

[1] Unless otherwise noted, all economic value figures are taken from *NOAA Economic Statistics*

about the nature and extent of the risk provided by NWS and other analysts relying on NWS and other NOAA-generated data.

- These same weather forecasts permit energy industries to optimize the mix among high and low cost generation sources in order to provide electricity at the lowest cost.
- Benefits to US agriculture from NOAA's enhanced ability to forecast the El Nino and Southern Oscillation (ENSO) is estimated at $300 million per year, with benefits and applications across a wide range of economic sectors from transportation and construction to retail trade.
- NOAA's geomagnetic storm forecasts are estimated to save the North American electric generating industry upwards of $150 million per year.
- Next generation Polar satellite sensors are estimated to provide nearly $100 million annually in benefits from better ship routing.
- The information from the network of data buoys around the nation is now made available in near real-time over the Internet to millions of ocean users in order to help them plan their activities. The value of these services is still to be determined, but a recent estimate suggests that the benefits for just one regional system in the Gulf of Maine could be in the order of $30 million per year.
- NOAA's navigational charts have been converted to electronic format, and, when coupled with Global Positioning System (GPS) receivers, permit even small recreational boats to have their position continuously shown on a computer screen at the helm. This combination of NOAA information with improved information technologies creates new markets for goods and services worth tens of millions of dollars annually.

- The development and widespread use of geographic information systems (GIS) has made it possible to see the interaction of human activity, wildlife habitat, and environmental change more clearly than was possible when mapping had to be done by hand. NOAA's Coastal Services Center integrates data from a variety of sources and makes the data available in GIS format for use by federal, state, and local agencies and by the private

sector. The result is better anticipation of potential impacts from proposed developments and review processes based on shared information.

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The benefits of these improvements and expansions of NOAA's information services build directly on the science and technology transforming the information economy. Greatly expanded computing power and improved sensors like NEXRAD makes better weather forecasts possible. The Internet, wireless communications, and personal computers make it possible to access NOAA information almost anywhere in the country and world, and at a cost that is accessible to almost everyone. Each of these new services adds to the economic wealth of the nation by providing new, more valuable, or lower cost services, and represents a major part of NOAA's economic output. Benefits to international users raise their incomes and result in increased demand for U.S. goods and services.

NOAA and the Coastal and Ocean Economy

NOAA's missions include significant responsibilities for the management of coastal and ocean resources primarily through the National Ocean Service and the National Marine Fisheries Service and by providing critical information for use by other agencies such as E.P.A. and the Department of the Interior. These agencies directly and indirectly affect a significant portion of the U.S. economy. With 11 % of the landmass, the coasts of the U.S. are home to more than 50% of the population, Y%$ of the employment and Z% of the U.S. GDP [figures to come from National Ocean Economics Project]. Just to take one specific example, the fisheries for which NOAA is responsible are worth about $28 billion to the U.S. GDP annually. Others include NOAA's responsibilities in the potentially valuable EEZ.

These figures also represent only a part of the picture. Eight of the ten largest metro areas in the U.S. are on the ocean or Great Lakes coasts. But the coasts also encompass some of the most remote rural communities in the United States, including the Northern Marianas and the Aleutian islands in the Pacific and the island communities of Matinicus and Monhegan off the coast of Maine. The ocean and coastal economy-- the portion of the

economy that depends on the ocean in each of these areas-- varies from a small share of the total economic activity to the lifeblood of the community.

These varying roles across the nation are made more complex by the interactions among the various uses of the ocean and coastal areas. In economic terms, there are two broad classes of economic interaction on with the coasts and oceans.

One is what the ocean and coasts provide:

- Amenity values. The increased value of a house or other real estate with a shoreline location- or just a view of the ocean is an indicator of the high demand that Americans place on being near the water.
- Recreation values. The oceans and Great Lakes are, together, perhaps the single most popular location for recreational activity in the country. Over 90 million Americans participate in marine outdoor recreation annually. Whether it is boating, swimming, or viewing sea birds, use of the coasts for recreation and leisure has become one of the most important economic uses.
- Food. America's multibillion-dollar seafood industry supplies food products to every part of the nation as well as being an important export.
- Transportation. More than 95 percent by weight and 20 percent by value of America's imports and exports arrive and depart by sea. Without its seaborne commerce, the American economy would quickly grind to a halt.
- Undersea cables are a critical part of the telecommunications infrastructure, linking countries and facilitating trade and commerce.

A second major element of the ocean and coastal economy that is critical are the risks from living on the coast.

The most obvious of these are associated with weather events such as hurricanes. Coastal storms account for more than 70% of the economic damage from weather events

annually. Hurricanes and tropical events are the most obvious causes, but winter storms can also be large sources of damage. Another major source of risk is the problem of harmful algal blooms. These naturally occurring increases in certain algal species can have a devastating impact on seafood as a result of the toxins released by the algae into commercial shellfish species such as clams and oysters. One such event in Maryland in 1997 cost the oyster industry more than $50 million in lost sales.

These various economic uses of the coasts and oceans together comprise both a huge addition to national wealth, and an important risk to it. The economic task of NOAA in this role is to: 1) assist in generating the maximum possible wealth from the coasts and ocean (measured both by such measures of economic activity as the Gross Domestic Product and by various measures of economic wealth not directly generated in market transactions, like the recreational value of a day boating or swimming at the beach or bird watching) and, 2) helping to minimize the risks to that wealth generation from the very process of living on and using the resources of the coasts and oceans.

Put another way, there are two tradeoffs: 1) the tradeoff between the benefits of human activities vs. the associated increase in exposure to nature from living along the coasts, and 2) the trade-offs among human activities. More of one of the benefits sometimes means less of another. More valuable coastal housing may mean less land available for recreation. Development for expanded ports may reduce spawning ground for commercially valuable fishery resources. There are also conflicts within the uses. Expanded recreational fishing activity may reduce commercial catches, and vice versa. And the competitive nature of open access commercial fisheries means that there is an inherent tendency towards short-term gains at the expense of long-term sustainability.

NOAA serves as both a direct and indirect resource manager. It has principal responsibility for managing fisheries in federal waters and for the management of specific marine areas such as the nation's marine sanctuaries. In many of its other roles in the coastal and ocean economy NOAA's activities are undertaken in partnership with other federal agencies such as EPA, FEMA, and DOI or with state and local governments through such programs as Coastal Zone Management.

Using Economics in Strategic Planning

Economics is nothing more than a means to understand how best to allocate scarce resources and each of these paradigms presents a different problem in that regard. **NOAA's mission, however it may be stated, is to increase the national wealth by providing information services and by helping to choose the best uses of the ocean and coastal areas.** Each task has somewhat different implications for what might be considered in a strategic plan, and there are some elements in common between the two paradigms.

In undertaking its "information economy" tasks, NOAA's basic problem is finding the resources it needs in order to improve its services and to use the resources it does have as well as possible towards this objective. Since there is never sufficient funding from the Congress or revenues from services to do all that is desired, the most central issue for strategic planning is deciding what information services are most valuable, and then finding the combinations of technologies, funding, and personnel to produce those services, whether from within the Agency or in combination with others. An additional goal is to utilize arrangements for providing services that encourage efficiency.

In undertaking its "coastal and ocean economy" tasks, there are two trade-offs: 1) the tradeoff between the benefits of human activities vs. the associated increase in exposure to nature from living along the coasts, and 2) the trade-offs among human activities. NOAA's challenge is to develop methods to guide choices among the various uses for which it has responsibility in the most socially and economically desirable manner. The economic tools of environmental economics such as environmental valuation can provide some direction, particularly by linking science, policy, and management through traditional tools such as cost benefit analysis

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Hudson's analysis of environmental and resource management notes two themes in particular: 1) economic development as complimentary to environmental improvement

rather than as a trade off in policy-making and, 2) new regulatory approaches favoring initiatives with the highest benefits relative to costs and market-based incentives.

The question then becomes: where does economics fit into the strategic planning process? At its heart, strategic planning is a simple process. It requires an organization to answer the following questions:

1. What do we seek to accomplish in the period covered by the plan? Here lies discussion of mission, goals, objectives, purposes, etc., all of which are variations on this question.
2. What resources do we have to accomplish those objectives? Resources include people, partnering organizations, money, technology, information resources, etc.
3. What deployment of available resources will best allow us to do what we want to accomplish.

Strategy, and economics, is about choice. A plan that says, " we will continue everything we are doing" is not really strategic, because it does not take into account changes that the agency may wish to undertake or changes that may be forced on it by external factors. A public agency such as NOAA that is ultimately responsible to Congress for its mission and resources has somewhat limited strategic flexibility, but still must make some choices. Strategic planning requires an evaluation of the resources available and decisions about whether to secure additional resources or not. Finally, it forces choices about how to deploy the resources expected to be available. In these tasks, a good understanding of economic information is critical.

From a strategic planning perspective the following questions would need to be addressed:

A. In setting mission, goals, and objectives:

1. What is the value of the information services NOAA provides, and what are the major factors affecting those values? How will the influences change over time

and affect the value of services, especially where services require long lead times to develop or are intended for use over a long period of time?

2. Among the uses of the coasts and ocean, where are the largest conflicts? From an economic perspective, the largest conflicts are those where either the values affected by the conflict are the greatest, or the costs of not resolving the conflicts are the greatest, or both.

B. In evaluating resources available:

1. What strategic opportunities exist in the applications of technology, in organizational and personnel roles, and in securing funding resources that will permit NOAA to address the first two questions?

C. In deciding how to deploy resources:

1. Which options in technology, people, organizations and funding are likely to be the least costly and most effective?

It is apparent that the amount of information that would be desirable to have in order to answer all of these questions is quite large, and equally apparent that it is not likely to be available in a timely manner. But there are ways to organize existing information to help answer these questions.

For NOAA's knowledge economy roles, it is likely that the highest value information is that with the largest group of beneficiaries and within those categories, that which is available fastest and with the most accuracy and at the greatest level of geographic detail. In some cases, NOAA's role goes beyond providing information to include developing methods for wider use and analysis and recommendations. Setting objectives to produce information with the desired combination of characteristics is likely have the highest value. For example, as noted, households are the single largest beneficiaries of NOAA weather information, and within that sector, improvements in one-day forecast accuracy is valued

above other attributes such as geographical specificity or frequency of updates [Stratus, Weather}.

The net benefits from investments in forecast improvements in the public sector probably dominate benefits among other user groups. But there may be tradeoffs with certain kinds of forecasts. For example, urban heat wave warning systems are effective in saving lives, particularly among the elderly, at miniscule costs [Teisberg]. Further, measuring benefits of more accurate and detailed hurricane forecasts in terms of reduce fatalities and evacuation costs may understate total benefits significantly because other preparation costs avoided by the public may be of even greater benefit than direct costs avoided [Stratus, Hurricanes]. These are examples where strategic planning needs to set guidelines for making choices. Economics can help by identify preferences (values) for one attribute of information over another.

In assessing resources available, there are clearly numerous developments in the technologies of gathering, storing, analyzing and communicating data that need to be assessed. NOAA is a world-leader in many aspects of the technologies with which it works, and that expertise can be relied on to define the technical issues, and to a great extent many of the cost issues (as these are reflected in the costs of building, deploying, and using the technologies).

But there are other economic issues that should be considered. For example, relative roles of the public and private sectors in distributing the information generated by NOAA, and in creating value-added services are important factors that also define the resources available to NOAA to fulfill its knowledge economy missions. NOAA has already been working with the private sector to generate more than $2 billion in investment in satellite information technologies.

NOAA has both cooperative and competitive relationships with the private sector in the information services. For the most part, NOAA has sole responsible for collecting much of the critical data and making it available. But interpreting and communicating the data takes place in many different organizations. The most obvious is in the case of weather

forecasts, which are produced and disseminated both by the National Weather Service and numerous private forecasters. These arrangements of shared responsibility have clearly worked to the public benefit as people have a choice of outlets and forecasters from which to get their weather information.

Hudson's Trend Analysis notes the rise of new business organization models such as the virtual or networked corporation and the impact of information technologies on the competitiveness of both large and small organizations. Similarly for NOAA. For example, as new media like the Web make the dissemination of information cheaper and easier, and as new information products like those of ocean observing systems become available and increase in demand, the appropriate "business model" for the various information products of NOAA will become a bigger issue. Through its PORTS program of cost sharing of ocean-observing data with maritime transportation companies, NOAA has demonstrated the desirability and feasibility of different business models for its knowledge economy role.

The proliferation of new partnerships--and opportunities for competition--will present a number of important strategic choices for NOAA as the agency seeks to inventory its resources. In doing so, it will have to operate in a rapidly evolving environment in which bright-line distinctions between "public" and "private" are less and less likely to exist. As the Hudson study put it "Increasingly, the question is not what government should do, but what government should take responsibility for." Good economic information about the value of services provided will be needed so that NOAA and the private sector can make appropriate choices about their roles.

In attempting to answer the third question about the deployment of resources, the economic tools of cost-effectiveness and cost-benefit analysis are particularly helpful, but both require good measures of "effectiveness" and "benefits" that are often lacking. An analysis of the Economics of NOAA Performance Measures [NOAA Chief Economist] discussed some of the issues involved in identifying and developing such measures, and noted that at least preliminary information may be available from a number of sources inside and outside NOAA. At the least, measures of speed, accuracy, and geographic detail that would form the basis for selecting the objectives of NOAA's information services strategies

could be compared with cost estimates on a normalized basis (e.g., cost per year of accelerated data availability) to help make some of these decisions.

Answering the strategic planning questions for NOAA's role in the ocean and coastal economy is more difficult because the interactions and tradeoffs among the various elements of the economy are much more complex. One perfectly valid approach is to recognize that NOAA's missions are already well defined in these areas and the objective set forth in previous strategic plans, such as sustainable fisheries and assuring healthy coasts remain valid. But it is also possible to recognize that the actual definitions of "sustainable" and "healthy" remain sources of continued assessment and evaluation, and that part of NOAA's strategic focus over the next planning horizon will be to develop economic information that gives more precise meaning--and thus more precise policy direction to these concepts.

For example, NOAA is increasingly involved in developing detailed economic information on the impacts on local economic regions of management decisions in such areas as marine sanctuaries and fisheries. Such information is being developed generally on a case-by-case basis as the needs of particular decision processes dictate. As this, and other, information accumulates, NOAA may be able to develop more comprehensive and systematic understanding of some of the economic tradeoffs affected by the Agency's decisions. These more systematic understandings can become the basis for definitions of "sustainable" and "healthy" coastal ecological and economic systems that can be meaningful guides to strategic actions on the part of NOAA and its partnering federal, state, and local agencies.

Toward a Strategic Economic Plan for NOAA

A brief summary of NOAA's economic strategic plan may thus be:

1. Develop economic data of the value of information services produced directly and indirectly by NOAA to both help decide what NOAA's priorities in these areas will be and how NOAA and the commercial and non-profit sectors will interact to maximize the value of these services.

2. Use existing information to develop cost-benefit and cost-effectiveness assessments of the choices NOAA is evaluating in its strategic planning process.

3. Use economics to provide increased definitional and measurement clarity to such terms as "sustainable" and "healthy". In doing this, an economic dimension needs to be added to the ecological dimensions that underlie NOAA's strategies.

4. Examine where economic incentives can be introduced.

5. Examine where economic principles provide lessons for organizational structures and public/private relationships.

6. Make developing economic information that will be critical to assessment of the current strategic plan's success and to the development of future strategic plans a priority in its own right in the strategic plan.

The status of available economic information, both in quantity and quality, to conduct the kind of assessment suggested here is highly variable. In fact, it is doubtful that NOAA can fully use economics to develop the current strategic plan. But as the fourth task above suggests, NOAA can make getting the information it needs an important goal in and of itself, and can also develop ways to use economic information and analysis to assess progress in attaining goals set forth in the strategic plan. This can be done both by committing to increasing the availability of economic information by NOAA, and by developing specific approaches to existing information, including:

A. Inventory existing information

A large amount of economic information is actually available concerning most of the policy areas for NOAA, some conducted by NOAA agencies themselves, others by outside agencies. Economic benefits are already being measured for a variety of NOAA

activities in the climate and weather areas; significantly less benefit data is available about many key ocean and coastal programs**.** The inventory should assess:

Scope of information
Geographic coverage
Research methods and quality

The Social Science Panel of NOAA's Science Advisory Board has recently completed an assessment of social science information that is produced and used by NOAA. This assessment may provide a good beginning to the inventory process.

B. Build on current procedures

Some agencies in NOAA already conduct extensive economic analysis. This is particularly the case with NMFS. As suggested above, this provides an opportunity to establish improved economic information as a performance goal itself, at least in the near term as NOAA builds capacity to use economics, and develop improved information as the economic analysis of existing programs (such as fisheries management plans) is developed.

C. Use Evaluation Opportunities

Evaluation of program outputs is an essential part of the strategic planning process. This involves more than just collecting the appropriate data for the measures and assessing progress towards the attainment of defined goals. It means conducting detailed assessments of program elements, including what is accomplished, how much it costs, whether the effects of the programs are in line with expectations (both of the agency and its "customers"). The evaluation of NOAA's programs takes place through both internal and external peer reviews and through what are described as "extensive informal networks". NOAA also noted that some of its research is subject to review in

the process of litigation. Input from constituencies is also sought. There are also periodic special program evaluation studies conducted.

However, there does not appear to be a systematic effort to incorporate economic considerations into program evaluations. This not only deprives NOAA of potentially useful information for specific programs, it also misses an important opportunity to collect economic information that can be useful in building economic performance measures. As regular program evaluation initiatives are planned, the potential to incorporate an economic component should be assessed. In doing so, cross-agency communication about the use of economic analysis in evaluations should be as complete as possible in order to avoid duplication. These factors should be an important consideration in establishing NOAA's new PA&E function.

D. Build data

While the incremental use of past and current opportunities for research will form a foundation for using economic analysis for performance measures, it will not be sufficient. A concerted effort will be needed to build the research base on which performance measures can be based in the future. The National Ocean Service is currently funding an effort (the National Ocean Economics Project) to develop part of the needed data, but this effort compiles existing information and there is much research that still needs to be done. This is particularly the case with respect to economic values associated with weather and climate. An economic research agenda could be developed from the assessment of existing information, the data developed in current procedures, and the evaluation process. This should be the precursor to a sustained effort to develop the required information upon which performance measures can be based.

D. Make Use of Incentives

Go beyond performance measures to examine incentives and organization of activities. Develop and evaluate incentive approaches and organizational arrangements for the kinds of efforts

they induce and the results achieved.

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